Community and occupational health concerns in pork production: A review[1]

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ABSTRACT: Public concerns relative to adverse consequences of large-scale livestock production have been increasingly voiced since the late 1960s. Numerous regional, national, and international conferences have been held on the subject since 1994. This paper provides a review of the literature on the community and occupational health concerns of large-scale livestock production with a focus on pork production. The industry has recognized the concerns of the public, and the national and state pork producer groups are including these issues as an important component of their research and policy priorities. One reason large-scale livestock production has raised concern is that a significant component of the industry has separated from traditional family farming and has developed like other industries in management, structure, and concentration. The magnitude of the problem cited by environmental groups has often been criticized by the pork production industry for lack of science-based evidence to document environmental concerns. In addition to general environmental concerns, occupational health of workers has become more relevant because many operations now are employing more than 10 employees, which brings many operations in the United States under the scrutiny of the US Occupational Safety and Health Administration. In this paper, the scientific literature is reviewed relative to the science basis of occupational and environmental impacts on community and worker health. Further, recommendations are made to help promote sustainability of the livestock industry within the context of maintaining good stewardship of our environmental and human capital.

Key words: environment, health, swine

J. Anim. Sci. 2010. 88(E. Suppl.):E102–E111
doi:10.2527/jas.2009-2554

INTRODUCTION

Since the ending of hunter-gatherer societies and the beginning of agricultural societies, there has been a trade-off between the process of producing food for society, and stress on the natural environment and people that provide the food. Furthermore, the advent of the industrial revolution in the early 1800s charted a path of increasing intensification of agricultural and nonagricultural industry that has further stressed the natural environment that we live in. The latter not only challenges the urban environment, but also our rural environments, as urban discharges and emissions reach the streams and air of our rural residents that connect urban and rural landscapes. As the economies of industrialized nations grew strong and basic necessities of life were generally cared for, the political and social controversies have increased as fewer people are involved in production agriculture.

Research has indicated that water and air pollution are now global issues, projecting environmental issues into the international arena. As production agriculture has become more concentrated into larger and more intensive operations, awareness and attention has increased from the public and regulatory agencies regarding water, air, and soil contamination and related community and worker health concerns. Emotions are increased among people who are concerned, complicating specific diagnoses for persons who claim to suffer health problems from these exposures. On the other hand, a large portion of the production agricultural community feels threatened that their industry has been negatively portrayed, and they fear excessive regulation will unnecessarily economically burden their operations, making it impossible to farm. For all these reasons, rural health professionals, livestock producers, veterinarians, and animal scientists should be as aware and concerned about environmental issues and their potential health effects, as are their urban counterparts.

[1]Based on a presentation at the Swine Symposium titled "Environmental concerns based on swine production" at the Joint Annual Meeting, July 12 to 16, 2009, Montreal, Canada. The symposium was sponsored, in part, by Land O'Lakes Purina Feed LLC, with publication sponsored by the *Journal of Animal Science* and the American Society of Animal Science.

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Received October 5, 2009.
Accepted February 5, 2010.

bial by-products contained in this dust as the primary hazardous substances. Endotoxin and 1,3-β-D-glucan, respectively, originate from the cell wall of gram-negative bacteria and certain yeasts, molds, and bacteria. They are known toxins and inflammatory mediators. The dust absorbs ammonia and possibly other toxic or irritating gases, adding to the potential hazards of the inhaled particles (Donham and Gustafson, 1982; doPico, 1986; Sigurdarson et al., 2004). A recent study has shown that the mixed exposure to dust and NH_3 in CAFO results in 2 to 4 times the health hazard (assessed by decline in pulmonary function over a work period; Donham et al., 2002).

At least 160 different gases are generated in anaerobically degenerating manure. However, H_2S, NH_3, CH_4, CO_2, and CO are the primary hazardous gases present (Donham et al., 1982; Donham and Gustafson, 1982; Donham and Popendorf, 1985). These gases may escape into the work environment in buildings with manure pits under the building. Furthermore, 40% of the NH_3 measured in-building is released by bacterial action on urine and feces on the confinement house floors (Donham and Gustafson, 1982). Carbon monoxide and CO_2 are generally not produced in hazardous concentrations from the manure pit but may rise to toxic concentrations from fossil-fueled heating systems in winter as well as by the respiration of the animal (i.e., CO_2; Donham and Gustafson, 1982). These latter gases are usually only hazardous when the heaters or ventilation systems malfunction. Methane is not a respiratory hazard in these buildings. However, CH_4 may be an occasional fire or explosive hazard in some buildings.

Who Is Exposed to These Dusts and Gases, and When?

In the United States, an estimated 700,000 people work in livestock and poultry confinement operations (Donham, 1990). This number includes owner-operators, hired farm workers, women, children, veterinarians, and service technicians. Included in the hired farm workers in the United States are minority populations, including those of Hispanic, Asian, and Bosnian descent, among others. The risk of acute and chronic respiratory health effects in CAFO workers are related to the relative genetic susceptibility to endotoxin or allergens of the individual, the length of time the person has worked, whether the person smokes or not, whether they have other respiratory conditions, and the concentration of exposures in these buildings. Although some individuals may have adverse health effects within the first week of work, most will not develop symptoms unless they have worked more than 2 h daily and for 6 or more yr (Donham et al., 1977, 2000; Donham and Gustafson, 1982).

Dust and gas concentrations increase in winter when houses are tightly closed and ventilation rates are reduced to conserve heat (Donham et al., 1977). Also, dust concentrations increase when animals are being moved, handled, and fed, or when buildings are being cleaned by high-pressure spray washing or sweeping (Nilsson, 1982). Ventilation systems are designed to control heat and humidity in the building and often will not reduce dust or gas adequately to ensure a healthful environment for humans. During the cold seasons, should the ventilation systems fail for several hours, CO_2 from animal respiration, combined with CO_2 and CO from heaters and manure pits, can rise to toxic or asphyxiating amounts. In the warm seasons, the greater risk to animals from ventilation failure is heat stress from elevated temperature and humidity. Although massive animal losses have been attributed to these latter situations, they would not create an acute human health threat because they are not so acute as to prevent workers from leaving the building in a safe time.

Hydrogen sulfide may pose an acute hazard whenever the liquid manure slurry is agitated (Osbern and Crapo, 1981; Donham et al., 1982). During agitation, H_2S can be released in seconds from usual ambient levels of <5 PPM to lethal levels of >500 PPM (Donham et al., 1988). The greater the agitation, the more rapid and greater the amount of H_2S that is released. Animals and workers have become seriously ill or died in swine CAFO when H_2S has risen from agitated manure in pits under the building. Several workers have died when entering a pit during or soon after the emptying process to repair pumping equipment or clean out solids (Donham et al., 1982; Beaver and Field, 2007). People attempting to rescue these workers also have died. Workers may be exposed to increased H_2S concentrations when they enter the pit to retrieve animals or tools that have fallen in or to repair ventilation systems or cracks in the cement. Hydrogen sulfide exposure is most hazardous when the manure pits are located beneath the houses. However, an acutely toxic environment may result from outside storage facilities if gases backflow into a building, due to inadequate gas traps or other design fault, or if a worker enters a separate confined-space storage facility.

How Commonly Does Excessive Exposure Occur?

Typical dust concentrations in swine CAFO are 2 to 6 mg/m^3 (Donham et al., 1985). Buildings with dust concentrations at 10 to 15 mg/m^3 may be seen during cold weather or when moving or sorting the pigs. The maximum recommended safe concentrations of dust to prevent chronic respiratory conditions is 2.5 mg/m^3 (Donham et al., 1995; Reynolds et al., 1996), which is considerably less than the 15 mg/m^3 for nuisance dust set by the Occupational Health and Safety Administration for industrial standards. The greater relative toxic nature of this dust is due to its high degree of its biological activity, its inflammatory nature, and the additive and synergistic actions of the mixed dust and gas exposures. Nearly 60% of swine confinement workers who have worked for 6 or more years experience